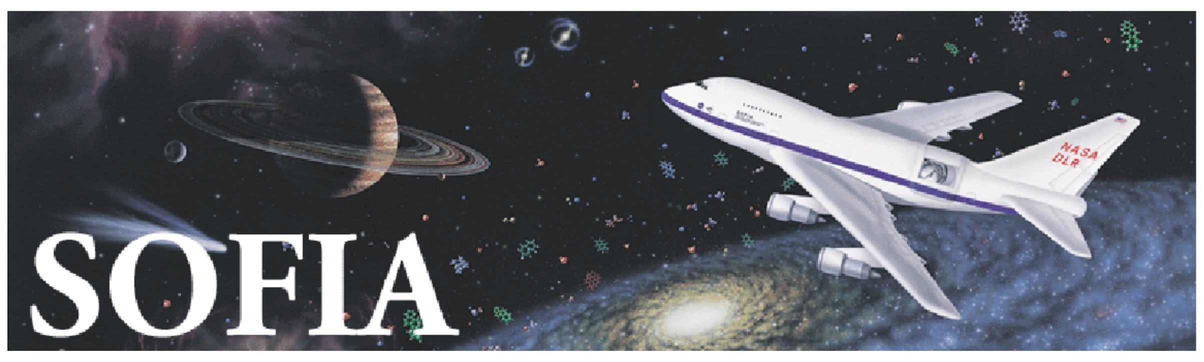
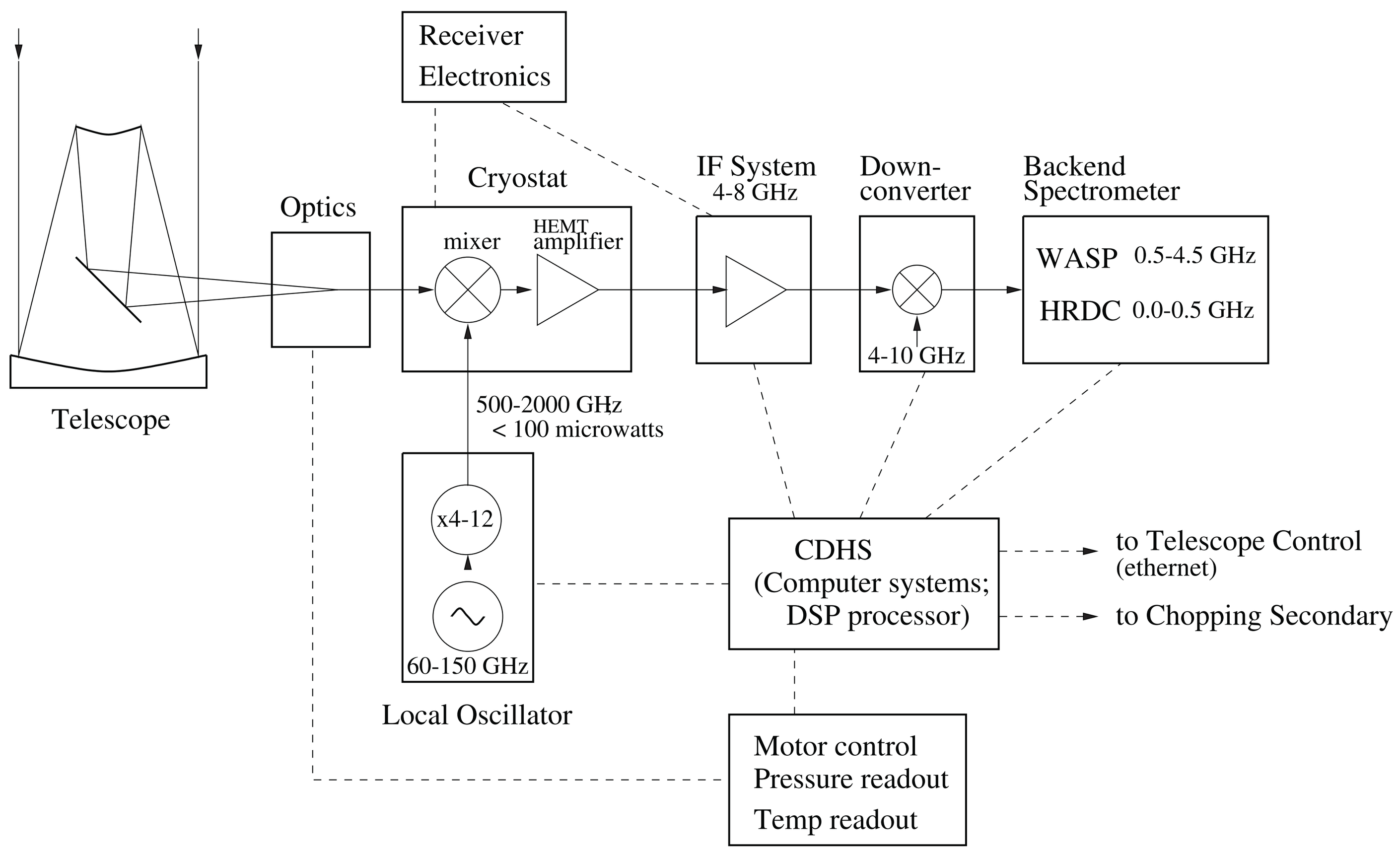
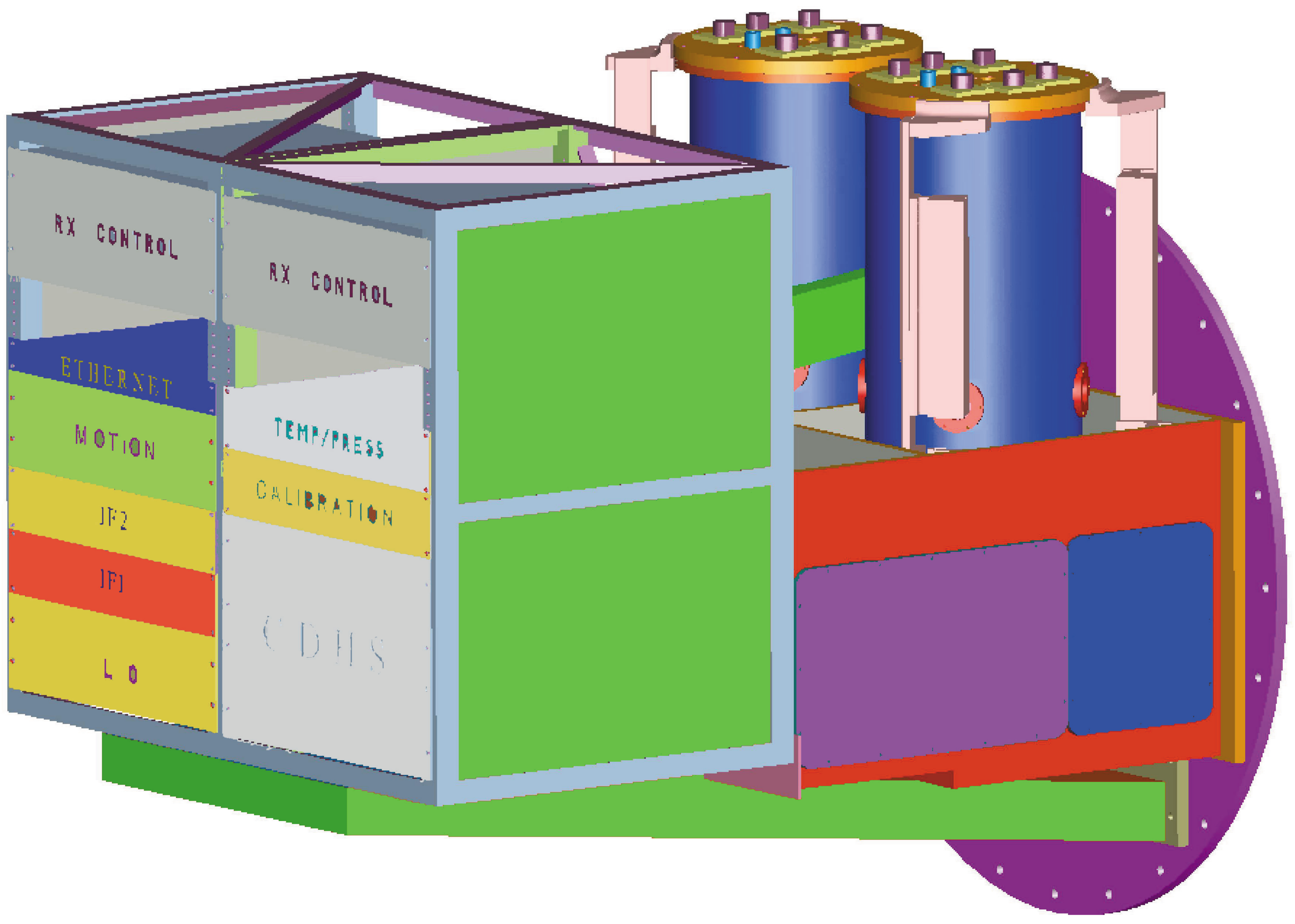
CASIMIR



Caltech Airborne Submillimeter Interstellar Media Investigations Receiver

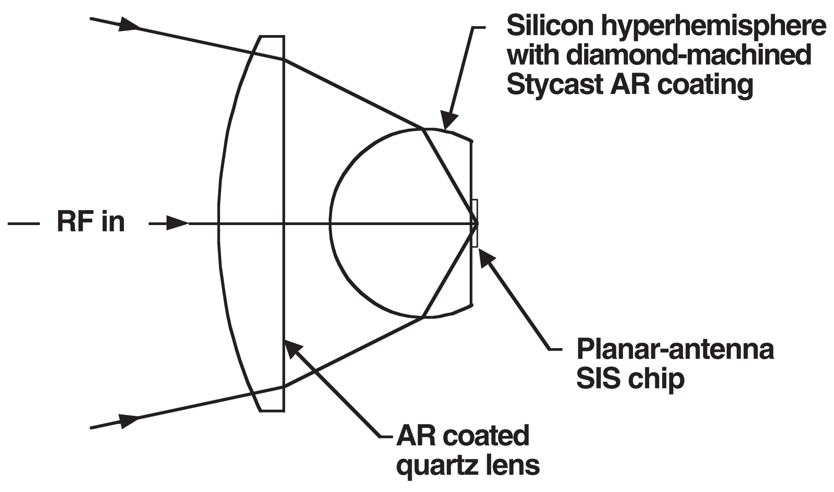
- Submillimeter/FIR Heterodyne Spectrometer
- Spectral Resolution: up to 10^6
- Multichannel: 8 channels total,
  4 channels per flight, 2 channels per cryostat.
- Wavelength Coverage: 150 - 600 microns (2 - 0.5 THz)
- Superconducting-Insulator-Superconducting (SIS) mixers will be used below 1.2 THz.
- Hot Electron Bolometer (HEB) mixers will be used above 1.2 THz.
- IF Bandwidth: 4 GHz
- Wide bandwidth analog spectrometer (WASP) covers entire 4 GHz band, continuously, with 256 Channels.
- High Resolution Digital spectrometer (HRDC) covers 500 MHz, with 2 MHz channels.

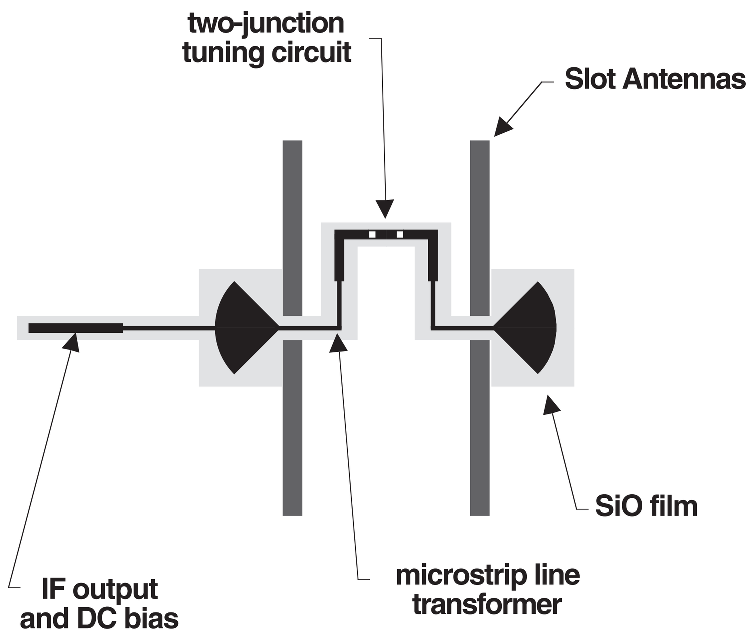




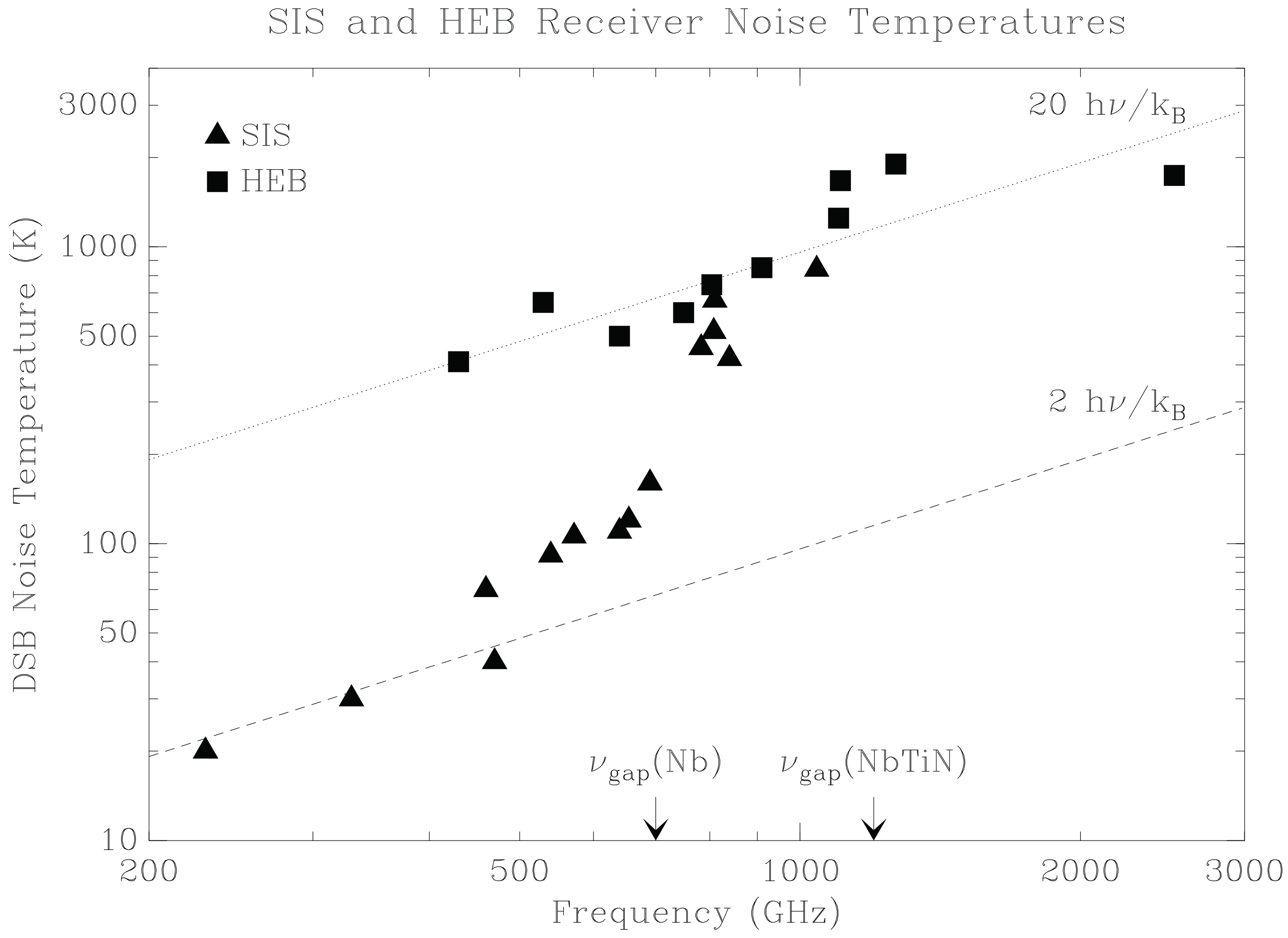
CASIMIR is approximately 1.5 meters long, by 1 m by 1 m and weighs 550 kg. The two cyrostats, the blue cylinders, are mounted on top of a box which contains all the relay optics and calibration systems. The local oscillators are solid state and continuously tunable, driven by either Gunn oscillators, or HEMT power amps. These are the pink structures visible in the figure, mounted on the sides of the cryostats. Almost all the electronic systems will be mounted in a rack mounted directly on the instrument, the green structure. The backend spectrometers will be mounted onto the counterweight of the telescope, preventing differential rotations and requiring only short cable runs. The instrument design is modular and extremely versatile, e.g. all optics systems can accommodate the full 8' FOV of SOFIA. Due to this versatility, CASIMIR will regularly be able to incorporate major improvements in detectors, LOs and spectrometers.

Advanced Mixer Technology in CASIMIR

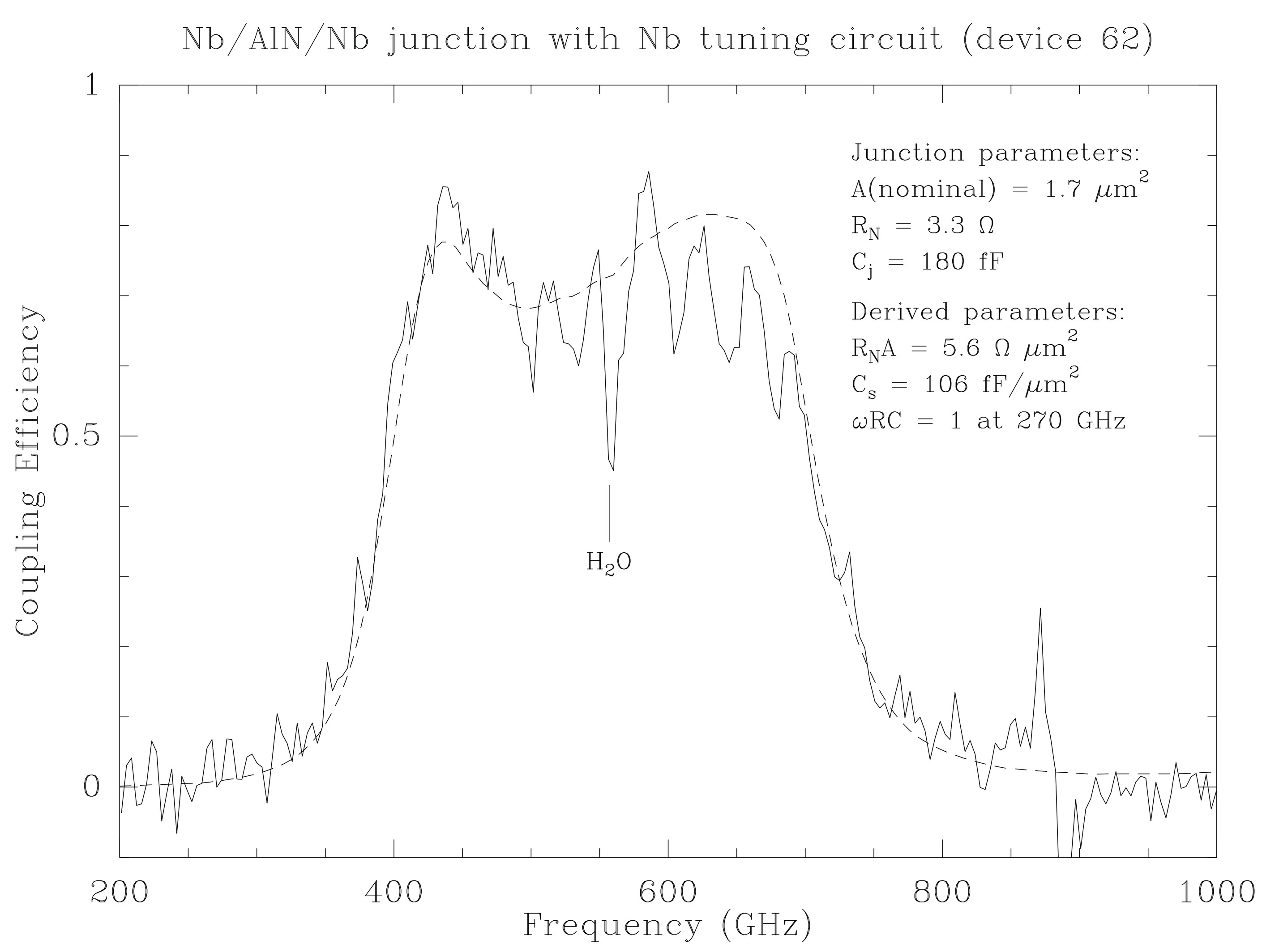




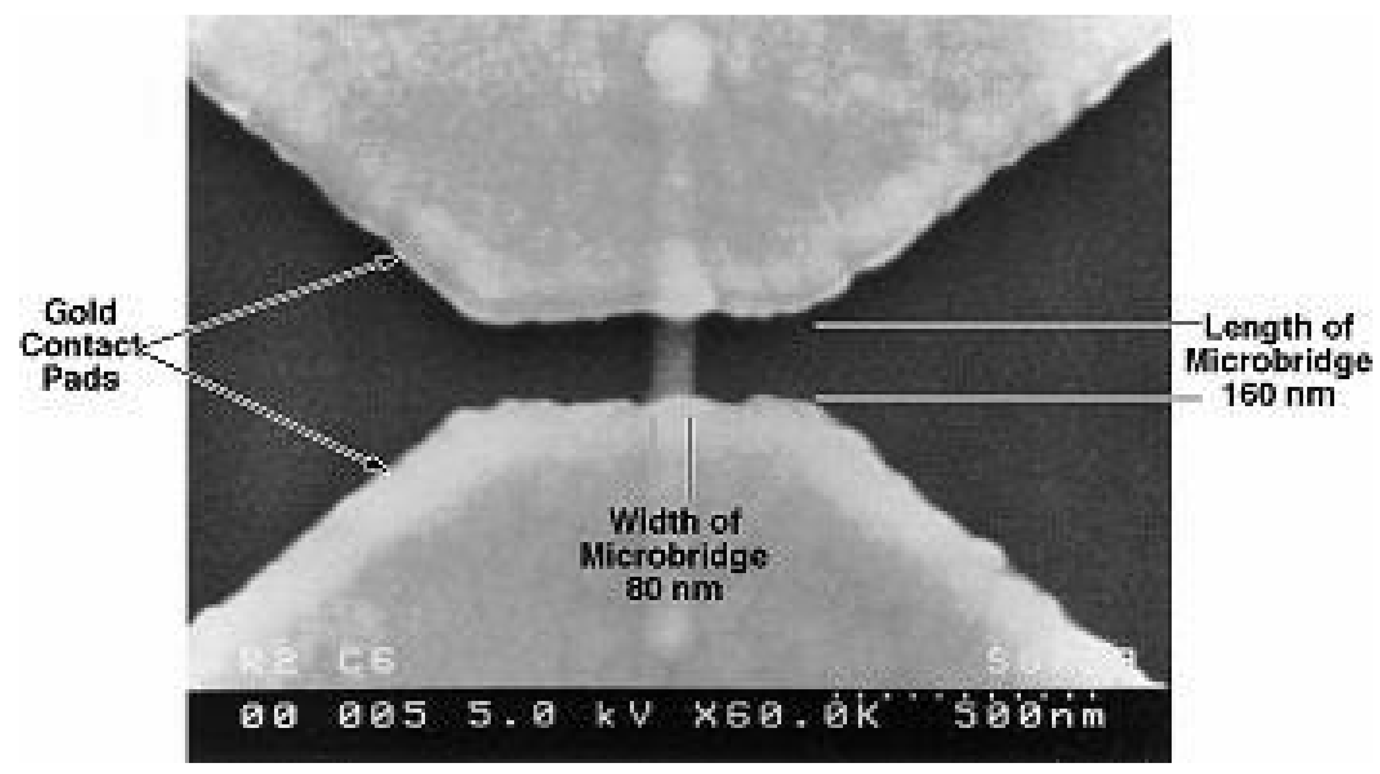
- All receivers on CASIMIR will be Quasioptically coupled Twin Slot Mixers.
- Twin slot antennae on silicon substrates have coupling efficiencies of up to 89%.
- Mixers are fabricated directly onto the silicon lens, which is a diamond machined, hyperhemispherical, silicon lens with an alumina loaded anti-reflection layer.



- Below Nb band gap, 700 GHz, SIS Mixers have achieved noise performances approximately 2 times the quantum limit.
- NbTiN has a band gap approximately 1.7 times that of Nb.
- NbTiN SIS mixers can be used at up to 1.2 THz,
  650 K DSB measured at 1.15 THz.
- Expect Noise Performance of SIS, above 700 GHz, and HEBs to improve significantly.



- Dotted line in figure represents predicted response.
- Replacing Aluminum Oxide insulating layer in SIS mixers with Aluminum Nitride, increases maximum current density.
- Current density increases by a factor of ~3, up to 35 kA/cm^2.
- Reduces losses in Nb tuning circuits.
- Increases tuning range from 100 to 300 GHz.
- SIS Mixers designed and tested at Caltech.



- HEB, Electron Diffusion Bolometer.
- Sensitive HEBs have been operated at up to 2.5 THz.
- Ultra-thin Nb layer, ~10 nm, fabricated into bridge by e-beam lithography.
- Low thermal capacity, due to small size, and electron diffusion yields high thermal conductance. The combination of the two produces very fast response times, on the order of tens of picoseconds.
- Fast response times yield IF bandwidths of 6-10 GHz.
- HEB mixers designed by W. R. Mc Grath, JPL.

CASIMIR Team

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LOs: N. R. Erickson, U. Massachusetts
MIxer Fabrication: H. G. Le Duc, JPL